



First record of *Dactylobiotus parthenogeneticus* Bertolani, 1982 (Eutardigrada: Murrayidae) in Mexico

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Abstract: In this paper we provide the first record of the eutardigrade *Dactylobiotus parthenogeneticus* Bertolani, 1982 from Mexico (North America). Our report increases the range of this species and the number of tardigrade species known from Mexico to 43 taxa.

Key words: Huasteca Canyon, North America, Nuevo León, Tardigrada, water bears

To date, only few studies on Mexican water bears have been conducted and the tardigrade fauna of this region is very poorly known. Up to now, only 42 tardigrade taxa have been reported from Mexico (Heinis 1911; May 1948; Schuster 1971; Beasley 1972; Claps and Rossi 2002; Pilato and Lisi 2006; Beasley et al. 2008; Kaczmarek et al. 2011), including only one freshwater species, *Doryphoribius evelinae* (Marcus, 1928) reported by Schuster (1971) from Chihuahua State. Moreover, 16 of the reported taxa represent rather doubtful records and need of confirmation (Kaczmarek et al. 2014b).

The genus *Dactylobiotus* Schuster, 1980 is widespread throughout the world and contains 17 exclusively freshwater species (Degma and Guidetti 2007; Degma et al. 2015). However, the taxonomic position of its type species *D. macronyx* (Dujardin, 1851) is still unclear and two other species, *D. aquatilis* Yang, 1999 and *D. henanensis* Yang, 2002, need to be re-evaluated; as taxonomically important characters were omitted in the original descriptions (see: Kaczmarek et al. 2008). In this short note, we provide the first report of this genus from Mexico.

All specimens were extracted according to Dastych (1980, 1985) and Ramazzotti and Maucci (1983) from an algal sample (*Stigeoclonium* sp.) collected from

the Santa Catarina River in Huasteca Canyon (Garza García Municipality, Figure 1) in June 2014. No eggs of *D. parthenogeneticus* were found in the field samples. However, some of the extracted specimens were put into Petri dish together with algae filaments and cultured until they deposited eggs. All individuals and eggs were fixed and mounted on microscope slides in polyvinyl alcohol with Evanol and lacto-phenol (PVA mounting medium from BioQuip Products Inc., catalogue number 6371A). Observations, measurements and photomicrographs were taken using Phase Contrast Microscopy (PCM) (AmScope T690C-PCT200-PL with digital camera AmScope MU1000). All measurements are given in micrometers (μm). Structures were measured only if their orientations were suitable. The body length was measured from the mouth opening to the end of the body excluding the hind legs. The macroplacoid length sequence is given according to Kaczmarek et al. (2014a). Claw lengths were measured according to Binda and Pilato (1999). Only external claws (anterior in claws IV) were measured. The *pt* ratio is the ratio of the length of a given structure to the length of the buccal tube, expressed as a percentage (Pilato 1981). Morphometric data were handled using the “Macrobiotoidea” ver. 1.1 template available from the Tardigrada Register (Michalczyk and Kaczmarek 2013).

The specimens of *D. parthenogeneticus* were identified using the keys in Ramazzotti and Maucci (1983), Kaczmarek et al. (2012) and based on the original species description (Bertolani 1982). The specimens are deposited in the Colección Carcinológica-FCB-UANL at Facultad de Ciencias Biológicas, Universidad Autónoma de Nuevo León, San Nicolás de los Garza, Nuevo León, México (FCB-UANL-TARDI-22 -LAM-0006, FCB-UANL-TARDI-22-LAM-0008, eggs: FCB-UANL-TARDI-22 -LAM-0007).

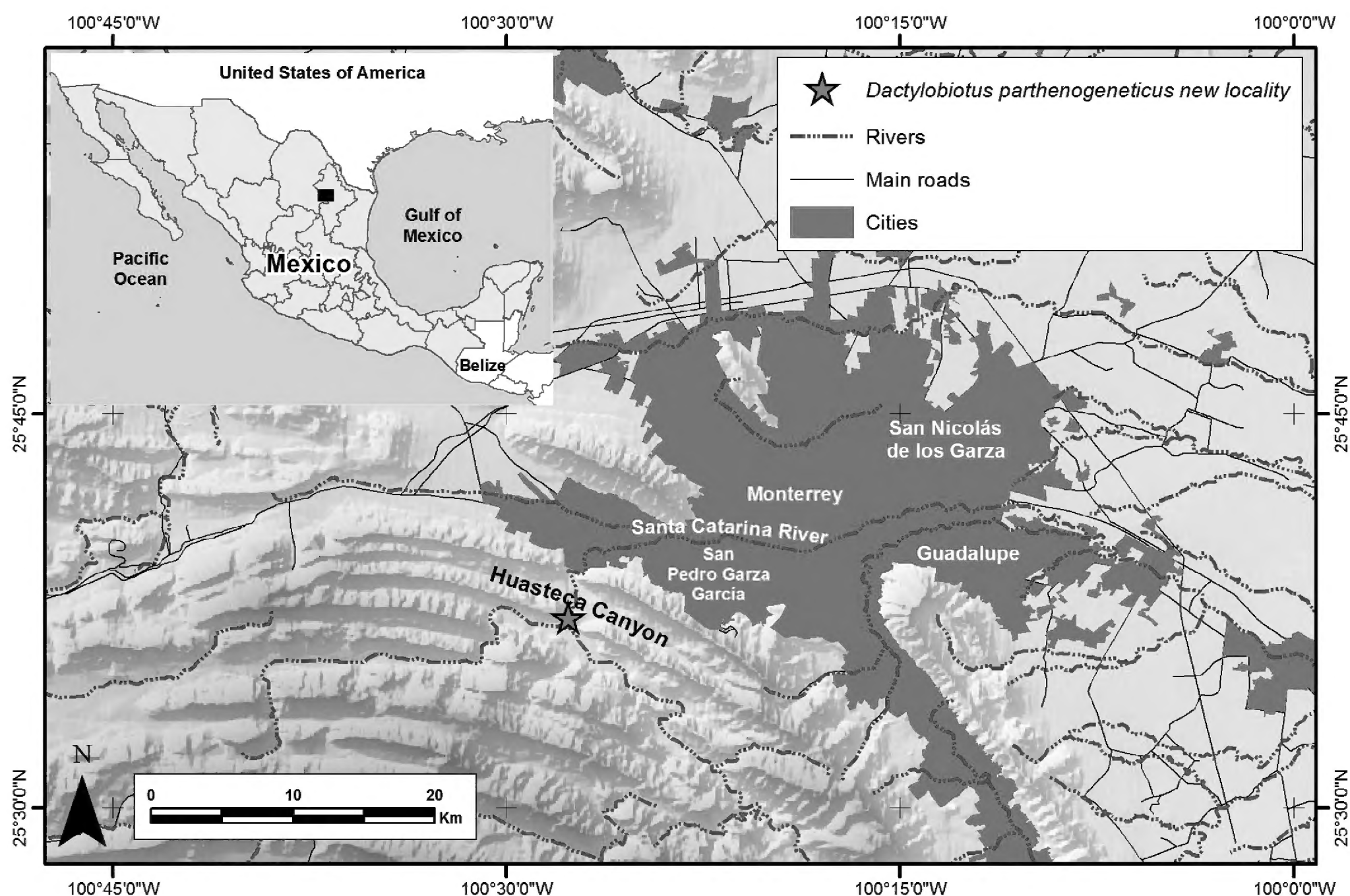


Figure 1. Map showing the first records of *Dactylobiotus parthenogeneticus* in México, state of Nuevo León.

Phylum Tardigrada Doyère, 1840

Class Eutardigrada Richters, 1926

Order Parachela Schuster, Nelson, Grigarick & Christenberry, 1980

Family Murrayidae Guidetti, Rebecchi & Bertolani, 2000

Genus *Dactylobiotus* Schuster, 1980

Dactylobiotus parthenogeneticus Bertolani, 1982

MATERIAL EXAMINED: 28 females from freshwater algae (*Stigeoclonium* sp.), 25°37'13.79" N, 100°27'38.48" W, Mexico, Nuevo León State, Garza García Municipality, Huasteca Canyon, Río Santa Catarina, and 10 eggs obtained from the laboratory culture.

DIAGNOSIS (measurements and *pt* values are given in Tables 1–2): Freshwater eutardigrade (Figure 2). Body white (in live specimens) or transparent (after fixation in PVA). Eyes present (in 100% of live specimens and in 80% of fixed individuals). Cuticle without gibbosities, spines or pores, but with two dorso-lateral conical papillae.

Bucco-pharyngeal apparatus of the *Macrobiotus* type with ventral lamina and ten peribuccal lamellae (Figure 3). Peribuccal *papulae* absent. Mouth antero-ventral. Oral cavity armature well developed, consisting of two bands of teeth. The first band of teeth in the anterior

portion of the oral cavity is absent or not visible under PCM. The second band of teeth placed in the posterior portion of the oral cavity, just before the third band of teeth. The band is continuous and composed of 4–5 irregular rows of small, densely arranged teeth. Teeth are rounded or slightly oval granules and spaces between teeth usually as wide as teeth themselves; these teeth decrease in size towards the front. The third band of teeth is composed of two ventro-lateral and two dorsolateral teeth, which are in the shape of transverse ridges. It has oval ventro-median and dorso-median tooth which are distinctly separated from the ventro-lateral and dorso-lateral teeth.

The buccal tube is rather narrow with ventral lamina and terminated in well-developed triangular apophyses. Pharyngeal bulb is round or slightly oval, containing two rod-shaped macroplacoids. First macroplacoid longer, with a central constriction and central projections, second macroplacoid shorter with a subterminal projection only. Macroplacoid length sequence: 1>2. Microplacoid and septulum are absent.

Claws of *Dactylobiotus* type (branch configuration 2-1-1-2), similar in shape on all legs. Claws of hind legs are distinctly longer. Lunules absent. Wide cuticular connections between internal and external claws

Table 1. Measurements (in μm) and *pt* values of selected morphological structures of specimens of *Dactylobiotus parthenogeneticus* mounted in PVA medium (N, number of specimens/ structures measured; Range refers to the smallest and the largest structure found among all measured specimens; SD, standard deviation).

Character	N	Range		Mean		SD	
		μm	<i>pt</i>	μm	<i>pt</i>	μm	<i>pt</i>
Body length	27	330–487	655–887	404	762	44.8	75
Buccal tube							
Length	27	47.4–59.0	–	53.0	–	2.8	–
Stylet support insertion point	27	35.3–43.6	70.1–76.5	38.9	73.5	1.9	1.5
External width	27	5.4–7.6	10.1–14.6	6.2	11.7	0.6	1.0
Internal width	27	3.1–6.7	5.7–12.8	4.3	8.1	0.7	1.3
Ventral lamina length	27	22.4–28.3	42.8–55.7	25.6	48.3	1.7	3.7
Placoid lengths							
Macroplacoid 1	27	10.4–14.9	20.9–27.4	12.7	24.0	1.2	2.0
Macroplacoid 2	27	5.8–9.2	11.7–16.9	7.3	13.7	0.9	1.4
Macroplacoid row	27	18.2–26.0	36.9–47.7	22.2	41.9	2.0	3.0
Claw 1 lengths							
External primary branch	26	15.2–21.5	29.1–39.0	18.7	35.3	1.6	2.5
External secondary branch	25	4.6–7.4	9.1–13.7	6.1	11.5	0.8	1.3
Secondary branch/Total claw ratio	25	0.25–0.46	–	0.33	–	0.5	–
Claw 2 lengths							
External primary branch	26	15.6–20.3	29.2–39.3	18.1	34.2	1.3	2.5
External secondary branch	26	4.7–8.0	9.5–15.7	6.6	12.5	0.8	1.5
Secondary branch/Total claw ratio	26	0.27–0.45	–	0.37	–	0.04	–
Claw 3 lengths							
External primary branch	26	15.3–20.9	30.2–39.3	18.3	34.5	1.5	2.6
External secondary branch	26	5.5–8.4	10.2–15.0	6.7	12.7	0.9	1.4
Secondary branch/Total claw ratio	26	0.29–0.45	–	0.37	–	0.04	–
Claw 4 lengths							
Anterior primary branch	25	17.9–27.2	35.2–50.2	23.2	43.5	2.2	3.5
Anterior secondary branch	24	8.5–12.2	15.1–21.5	9.8	18.5	1.1	1.7
Secondary branch/Total claw ratio	24	0.36–0.55	–	0.43	–	0.05	–

Table 2. Measurements (in μm) of selected morphological structures of eggs of *Dactylobiotus parthenogeneticus* mounted in PVA medium (N, number of eggs/structures measured; Min, the smallest; Max, the largest structure found among all measured eggs; SD, standard deviation, three processes per egg were measured).

Character	N	Min	Max	Mean	SD
Diameter of egg without processes	10	83.1	103.0	93.0	6.1
Diameter of egg with processes	10	92.0	109.7	102.2	6.0
Process height	30	3.5	5.0	4.3	0.4
Process base width	30	3.5	5.5	4.4	0.5
Process base/height ratio	30	0.77	1.33	1.03	0.16
Distance between processes	30	0.8	1.9	1.5	1.2
Number of processes on the egg circumference	10	37	44	41.8	2.0

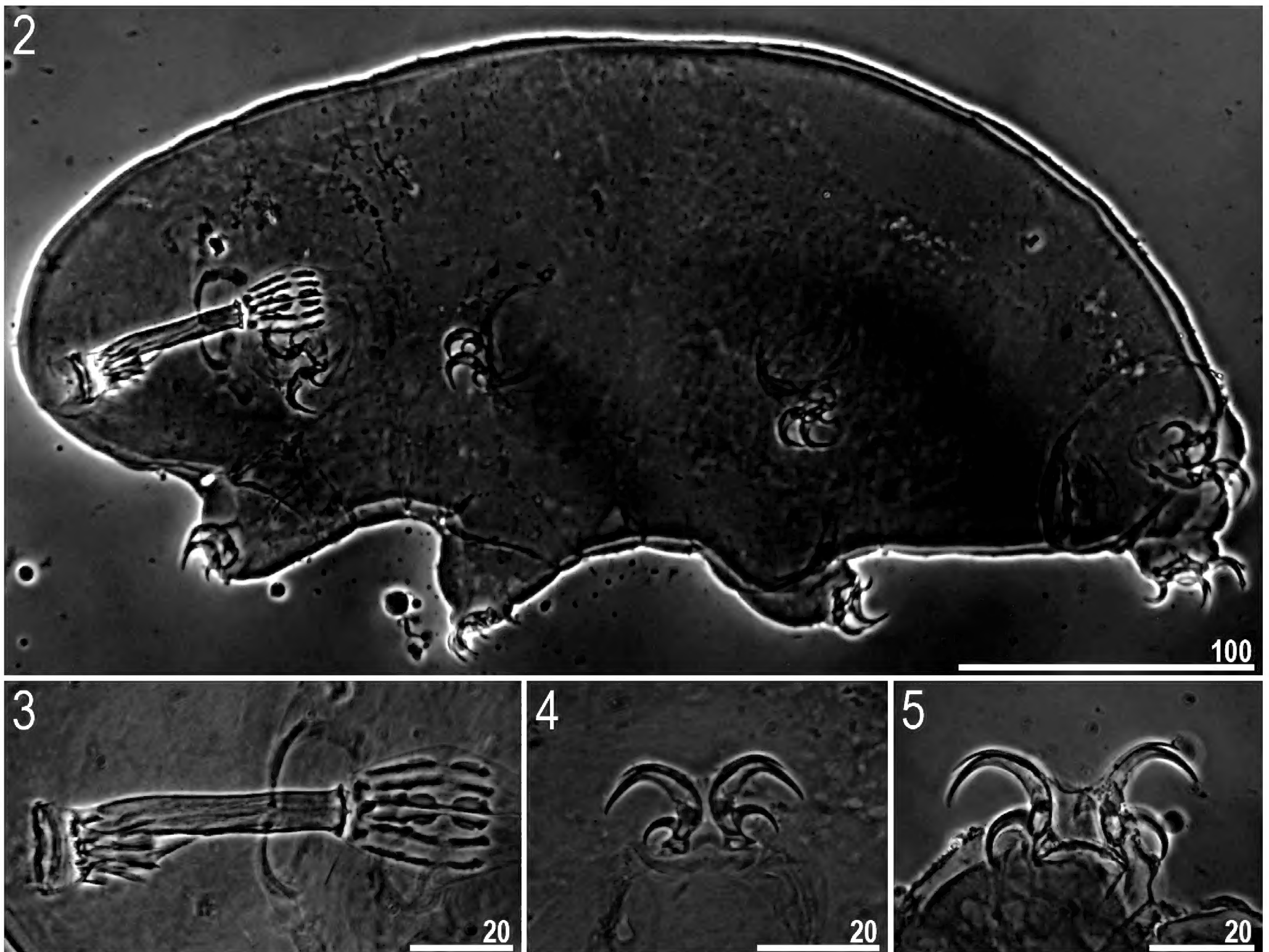
present on all legs. Accessory points well developed on the primary branches of claws (Figure 4), but better visible on hind legs (Figure 5).

Eggs are large spherical or slightly oval (Figure 6) and laid free. Eggs processes in shape of small, sharp and wide (at the base) cones. The majority of processes have a single sharp tip, but some may have two or even three tips (Figure 7). Processes and surface between processes smooth under PCM.

Dactylobiotus parthenogeneticus is known from Italy (Modena, Emilia, Sicily, Sardinia, Marche and Lazio), Greece and Spain (Despeñaperro, Jaen and Sumidero del Calderon, Cantabria) (Bertolani 1981, 1982; Binda and Pilato 1999; Guil 2002). In South America, the

species was reported from Buenos Aires and Las Pampas in Argentina and from La Paz in Bolivia (Meyer 2013; Kaczmarek et al. 2015). In this paper, we present a first record of this species from Mexico.

As it was mentioned in the introduction, the tardigrades of Mexico are very poorly known (for example, in Costa Rica, a country almost 40 times smaller, 61 taxa have been reported, while in Mexico there are only 42 (Kaczmarek et al. 2014b)). Out of 32 Mexican states, 23 have never had tardigrade reports. The state with the highest number of reported tardigrade taxa is Chihuahua, with 13 species, followed by Chiapas with 12 reported species. With this new record, the number of tardigrades from Mexico increases to 43



Figures 2–5. *Dactylobiotus parthenogeneticus* from México. **2:** habitus, ventro-lateral view. **3:** buccal tube. **4:** claws III. **5:** claws IV. All PCM.

species, from which 41 are terrestrial and only two are freshwater (Kaczmarek et al. 2011; Kaczmarek et al. 2014b). Moreover, it is the first record of tardigrade species for the state of Nuevo León.

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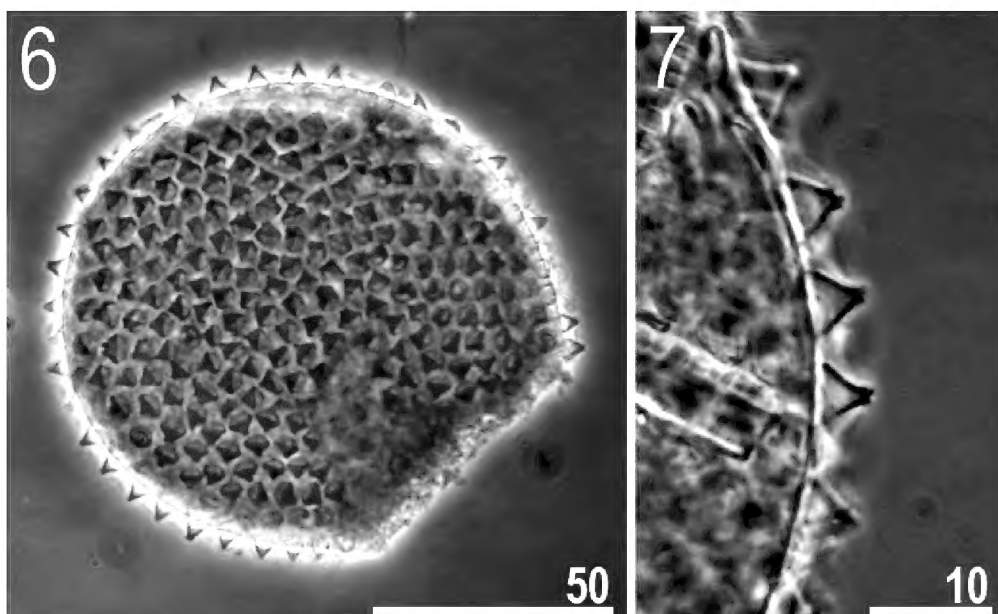


Figure 6–7. Egg of *Dactylobiotus parthenogeneticus*. **6:** Egg. **7:** Egg processes. All PCM.

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Authors' contribution statement: AMT collected part of specimens, collected the data, identified the specimens, wrote the text, and photographed the specimens; MR edited photographs and reviewed the text; PRG reviewed the text; JJFM reviewed and photographed the specimens; ŁK corroborated the identification, performed the comparative analysis of the specimens with the types and wrote the text.

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